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USDA Forest Service
Region 6

TM Biocontrol-1

Production History and Inventory Status

April 10, 1995

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TM Biocontrol-1 Production History and Inventory Status

Prepared by

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INTRODUCTION

TM Biocontrol-1 is a microbial insecticide produced by the USDA-Forest Service for Douglas-fir tussock moth Orgyia pseudotsugata (McDunnough) management. The active ingredient is a nuclear polyhedrosis virus highly pathogenic to the lepidopteran genus Orgyia, which includes Douglas-fir tussock moth. The insecticide was produced with the intention of having it available to protect forest resources by suppressing Douglas-fir tussock moth outbreaks.

The Forest Service obtained a registration for TM Biocontrol-1 from the Environmental Protection Agency in 1976.

Facilities and staff for operational production of TM Biocontrol-1 were set up in Corvallis, Oregon at the Pacific Northwest Research Station, Forestry Sciences Laboratory in 1980. This unit produced the nuclear polyhedrosis virus from 1980 until 1992. Production of the virus was stopped in August 1992 because the quantity of TM Biocontrol-1 available was considered sufficient to meet foreseeable needs for many years.

This report describes the production history of the Corvallis Douglas-fir tussock moth virus unit and provides information about the inventory of TM Biocontrol-1 available for use.

TM BIOCONTROL-1 TERMINOLOGY

Any discussion about TM Biocontrol-1 involves words, terms, symbols, and phrases not in common usage. In order for most readers to understand this report we need to define these terms.

Acre dose: The amount of TM Biocontrol-1 needed to treat one acre of forest. This is commonly expressed in the number of grams of specific storage lots of TM Biocontrol-1 needed to treat one acre. The acre dose rate needs to be determined for each tussock moth population to be suppressed.

Activity unit: The weight of specific storage lots of TM Biocontrol-1 needed to cause the death of 50% of test larvae from the Goose Lake lab colony. This is commonly expressed in nanograms. It is less commonly expressed in PIBs. The recommended acre dose of TM Biocontrol-1 is 1.085×10^9 activity units.

Bain Marie: The container used to store virus infected frozen larvae before virus recovery. A Bain Marie holds approximately 7 kilograms, which is about 5,400 larvae. 414 Bain Maries were filled with frozen virus infected larvae at Corvallis.

Bioassay: A test done on each storage lot of TM Biocontrol-1 to determine the amount of product needed for an acre dose. All bioassays were done using the Goose Lake lab colony

Goose Lake Colony: A laboratory colony of Douglas-fir tussock moth established from specimens collected in the vicinity of Goose Lake in Klamath County, Oregon. The Goose Lake colony was maintained at Corvallis on an artificial diet from the late 1960s until 1994. Only the Goose Lake colony was used as the substrate for virus propagation for TM Biocontrol-1 production. All bioassays to determine acre doses of the storage lots have used the Goose Lake lab colony.

Grams per acre dose: The number of grams of each storage lot of TM Biocontrol-1 needed to treat one acre. The quantity was determined by bioassays using the Goose Lake colony.

Lots: A quantity of TM Biocontrol-1 provided to the Forest Service by a company contracted to recover virus from infected larvae. Each lot has a unique combination of grams per acre dose rate and storage date and was a separate contractual action.

Nanograms: One billionth of a gram.

Packages: Each storage lot of TM Biocontrol-1 has packages, either bags or envelops, containing a specific number of acre doses of the technical grade insecticide.

PIBs: Polyhedron inclusion body. A protein crystal that contains virus rods. The PIBs in TM Biocontrol-1 contain two or more bundles of virus rods.

Processing Company: The establishment that recovered the virus (PIBs) from the frozen, infected larvae provided by the Corvallis virus production unit. The processing companies packaged TM Biocontrol-1 in specified quantities.

10^n The symbol 10^n refers to powers of 10. For example 1.068×10^{16} is equal to 10,680,000,000,000,000, the number of PIBs of virus produced at Corvallis.

TM Biocontrol-1: Technical grade Douglas-fir tussock moth insecticide containing nuclear polyhedrosis virus as the active ingredient. A dry powder consisting of PIBs and finely ground tissues and parts of tussock moth larvae.

Unprocessed virus: Virus in intact, infected frozen larvae. The virus has not yet been recovered from the cadavers by a processing company.

PRODUCTION HISTORY

The Corvallis Douglas-fir tussock moth virus production unit was established in 1980. The original goal was to produce 50,000 acre doses of TM Biocontrol-1.

The first two years were largely spent developing mass rearing and mass propagation techniques and gearing up for full scale production.

The start-up phase involved acquiring facilities and equipment capable of handling large numbers of Douglas-fir tussock moths. Two separate facilities were used. The Forestry Sciences Laboratory was used to prepare artificial diet, rear tussock moths, and as the unit

administrative office. A laboratory was set up at the Corvallis airport, approximately 5 miles from the Forestry Sciences Laboratory to inoculate insects and propagate virus. This was done to isolate virus handling operations and reduce the potential of inadvertently infecting the insects at the Forestry Sciences Lab. It also guarded against infecting insects at the airport operation with other pathogens, particularly Bacillus thuringiensis. A large inventory of specialized equipment was acquired to raise the insects, prepare and dispense artificial diet, infect the insects, and minimize the potential of contamination. Some of the equipment had to be custom built.

The start-up phase required greatly expanding the number of insects in the Forestry Sciences Laboratory Goose Lake colony. Bacterial diseases and molds initially hampered the efforts to expand the colony size. This was overcome by using a combination of antibiotics, heating of ingredients in the artificial diet to destroy microbial contaminants, and implementing strict sanitation measures for all phases of the work.

A staff of biologists and technicians was assembled to do the work. The unit was staffed seven days a week for several years because of the need to tend the insects.

The process used by the Corvallis Douglas-fir tussock moth virus production unit was based on procedures developed in the 1960s and 1970s by researchers with the Pacific Northwest Experiment Station. This process is described in Forest Service Technical Bulletin 1585, The Douglas-fir Tussock Moth: A Synthesis, on pages 140 to 147.

Insects used for virus propagation were reared at the Forestry Sciences Laboratory to the fifth larval instar. Part of each generation was kept to complete the life cycle and perpetuate the colony. Large numbers of fifth instar larvae were moved to the airport facility for infection. Larvae were infected after they ate artificial diet coated with nuclear polyhedrosis virus. All virus used for infection was derived from primary inoculum with known history provided by PNW Research. The primary inoculum was increased by infecting larvae from the Goose Lake lab colony and collecting the secondary inoculum. Secondary inoculum was subsequently used for all infections. The larvae were maintained at 25° C during the infection process. They were harvested as they died and placed into Bain Maries for storage prior to virus recovery. A sample of the dead larvae was examined to make PIB counts. Approximately 160 dead larvae were sampled to estimate the number of PIBs in each Bain Marie. Bain Maries of frozen, infected larvae were kept at Corvallis. A total of 2,878 kilograms of infected larvae were produced from 1980 to 1992.

Figure 1 shows the annual virus production of the Corvallis virus unit from 1982 until 1992 when production was stopped. A small amount of virus was produced in 1980 and 1981 as the operation was scaling up to full production. Peak production was in 1983 through 1986, with a total of more than 300,000 acre doses of unprocessed virus being produced in that period.

In 1986 a decision was made to reduce the unit's annual production level to 40,000 acre doses for two years and re-evaluate the need for continued production in 1987. In 1988 a decision was made to continue production but reduce to 20,000 acre doses annually. This was called the "quick start" alternative. It would have allowed the unit to achieve a production rate of 80,000 acre doses per year within one year if a decision was made to resume full-

scale production. Virus production stopped in August 1992 after a decision was made that there was sufficient TM Biocontrol-1 on hand to meet needs for the foreseeable future.

The Corvallis unit produced 502,162 acre doses of unprocessed virus from 1980 to 1992.

VIRUS RECOVERY, AND BIOASSAYS

Recovery of virus from frozen, infected cadavers was done by another Federal agency and three contractors. The Forest Service air freighted frozen Bain Maries to the processors and they recovered the virus from the insects. The recovery process involved homogenizing the larvae in water, screening the suspension to capture the virus, freeze-drying the suspension, and milling it to a fine powder. The specific process varied somewhat by processing company.

The processing companies sent samples of the recovered virus to Corvallis for bioassays to determine potency. This was done by exposing Goose Lake colony tussock moth larvae to several different quantities of the sample virus through dilutions. The virus dilutions were coated on the artificial diet to determine how much of the preparations was required to cause 50 percent of the test insects to die. All bioassays of TM Biocontrol-1 were done at Corvallis by Forest Service personnel. All lots, except for storage lots 9 and 10 were bioassayed by the same individual.

Virus quantities in shipments made to processing companies and recovered by them are shown in Tables 1 and 2. Approximately 600 acre doses of unprocessed virus were kept by the Forest Service for tests.

Data from the bioassays were provided to the virus recovery establishments. They used it to determine the weight of product to place in packages of various total acre doses specified by the Forest Service. The grams of TM Biocontrol-1 required for an acre dose, total grams produced, and total acre doses recovered from each storage lot are shown in Table 3.

The first virus recovery was done by the USDA-Agricultural Research Service, Otis Methods Development Center, Otis, Massachusetts. Bain Maries containing 18 kilograms of infected larvae were shipped from the Corvallis unit in 1983. A portion of the virus recovered by ARS was used for research done at that facility, the remainder, 1,680 acre doses, was provided to the Forest Service.

A contract was awarded to Reuter Laboratories, Incorporated of Manassas Park, Virginia in 1986 to recover virus from infected larvae. This contract was divided into four items. Reuter was sent 1,116 kilograms of larvae, containing an estimated 195,870 acre doses. They recovered 145,600 acre doses of TM Biocontrol-1.

In 1988, a contract was awarded to Espro, Incorporated of Columbia, Maryland to process 198 kilograms of larvae. Espro recovered 17,489 acre doses from the estimated 21,407 acre doses of unprocessed virus sent by the Forest Service. The weight of TM Biocontrol-1 required for an acre dose of this lot, 0.47 grams, was much less than lots previously received from other processors. Espro was awarded a multi-year contract for additional virus recovery in 1989. The firm received 819 kilograms of unprocessed virus in 1990 and recovered

153,077 acre doses of TM Biocontrol-1. In 1990 Crop Genetics, Incorporated of Columbia, Maryland purchased Espro and took over the multi-year processing contract. Crop Genetics received shipments of 413 kilograms of virus in 1990, 155 kilograms in 1992, and 164 kilograms in 1994. They recovered 69,050 acre doses, 14,784 acre doses, and 25,000 acre doses of TM Biocontrol-1 from these.

The Corvallis virus unit produced an estimated 502,162 acre doses of unprocessed virus. The processing companies recovered 428,680 acre doses, or 85.5 percent of the virus estimated to be present in the larvae they received.

TM BIOCONTROL-1 USES

Quantities of TM Biocontrol-1 from the production operation have been provided to users, Table 4. The Northern Region (R-1) got approximately 1,200 acre doses from storage lot 1 in 1985 for use in a pilot test of efficacy against Douglas-fir tussock moth in Idaho. In 1986 the Northern Region received 35,000 acre doses from storage lot 3 to use in an operational tussock moth suppression project in Idaho. Approximately 1,900 acres were sprayed and then the project was stopped because the population was collapsing from natural causes. The remaining 33,000 acre doses of unused product was returned to Corvallis. The British Columbia Forest Service purchased 20,000 acre doses of storage lot 3 from the Forest Service in 1986. They have used the virus on two studies to compare its efficacy to Virtuss, a Canadian nuclear polyhedrosis virus produced in white-marked tussock moth. Research entomologists at the Pacific Northwest Research Station used approximately 800 acre doses in a field test against tussock moth in Idaho in 1991. Approximately 500 acre doses have been used by testing laboratories doing tests to maintain the EPA registration.

TM BIOCONTROL-1 INVENTORY

The Forest Service inventory of TM Biocontrol-1 is kept in cold storage at the Forestry Sciences Laboratory in Corvallis. The insecticide is stored by recovery lots. Information on the storage lots is displayed in Table 5 and 6. There are 400,237 acre doses of TM Biocontrol-1 in the inventory.

Storage lot 1. There are only 480 acre doses in this lot. It has been stored since 1985. This is coarsest of all lots. It has to be strained through cheese cloth or equivalent to remove insect fragments before it can be sprayed.

Storage lots 2,3,4, and 5. These lots processed by Reuter Laboratories are less coarse than lot 1 and probably would not need to be strained. All packages in lots 2 and 3 contain 1,000 acre doses.

Storage lots 6, 7, 8, 9, and 10. These lots processed by Espro and Crop Genetics are very finely milled and do not require any straining prior to use. There are a large number of package sizes in these lots. They are all packaged in double sealed bags, with an inner vacuum sealed plastic bag.

COST

The total cost of producing 428,680 acre doses of TM Biocontrol-1 was about $3,190,000, or $7.60 per acre dose.

TM BIOCONTROL-1 LABEL, MATERIAL SAFETY DATA SHEET, AND TANK MIX INSTRUCTIONS

Figure 2 is a copy of the TM Biocontrol-1 label for storage lot 7. TM Biocontrol-1 is to be used by or under the supervision of the Forest Service.

Figure 3 is the Material Safety Data Sheet for TM Biocontrol-1. Some individuals are allergic to Douglas-fir tussock moth hairs and may experience a reaction called tussockosis. Part of the product is finely ground larvae. Users of TM Biocontrol-1, particularly those involved in mixing are advised to wear long sleeved shirts and medical face masks to reduce the potential of reactions. There should be supplies of eyewash, water, and soap available where the product is being used. Individuals who experience reactions should be assigned to other duties to reduce their exposure.

The tank mix instructions are shown in Figure 4. Feed grade molasses should be used. Studies are being done to improve the tank mix, with the objective of eliminating the molasses and lignosulphate. The tank mix should not be aerially applied at less than 1.0 gallons per acre because it evaporates rapidly in low relative humidities.

REQUESTING TM BIOCONTROL-1

TM Biocontrol-1 is available for use. It must be used by or under the supervision of the Forest Service. Those interested in getting a supply of the product must send a written request to the Regional Forester, Pacific Northwest Region, P.O. Box 3623, Portland, Oregon 97208. There will be no charge to Forest Service users of TM Biocontrol-1.

USING TM BIOCONTROL-1 FOR SUPPRESSING DOUGLAS-FIR TUSSOCK MOTH OUTBREAKS

If a decision is made to use TM Biocontrol-1 to suppress an outbreak of Douglas-fir tussock moth it is important to determine the correct dosage rate. All storage lots have been bioassayed against the Goose Lake laboratory colony that has been maintained in a laboratory under controlled conditions since the mid 1960s. Acre dose treatments of TM Biocontrol-1 needed to suppress wild populations of tussock moth could be different than the acre doses determined for the Goose Lake colony. The wild populations should be tested with a storage lot of the product to determine the proper amount of insecticide to use.

TM BIOCONTROL-1 TRIVIA

There are several facts about the production of TM Biocontrol-1 that have no practical application but may be of interest.

The Corvallis virus production unit produced ten quadrillion, six hundred eighty trillion PIBs of

tussock moth virus. This is 10,680,000,000,000,000. They did not count each one.

It took 15,617,039 larvae to produce the virus.

2,878 kilograms of frozen infected larvae were produced. This is 7,716 pounds, or about 3.9 tons of frozen caterpillars.

One kilogram of frozen larvae yielded an average of 135 grams of TM Biocontrol-1.

The average infected larva contained 678,745,824 PIBs.

One tussock moth egg weighs 0.7 milligrams.

One PIB weighs 0.025 nanograms.

TABLES AND FIGURES

Table 1. *Douglas-fir Tussock Moth Nuclear Polyhedrosis Virus Quantities Received and Returned by Processing Companies.*

	Received		Returned	
Company	PIBs	Acre Doses	PIBs	Acre Doses
Agric. Res. Service	$5.80*10^{13}$	2,727	$4.71*10^{13}$	1,680
Reuter	$4.16*10^{15}$	195,870	$3.68*10^{15}$	147,600
Espro	$3.86*10^{15}$	181,366	$2.15*10^{15}$	170,566
Crop Genetics	$2.58*10^{15}$	148,815	$1.63*10^{15}$	108,834
Totals	$1.59*10^{15}$	501,527	$7.51*10^{15}$	428,680

Table 2. *Acre Dose Recovery of TM Biocontrol-1 NPV by Processing Company.*

FS Lot #	Processing Company	Unprocessed Acre Doses	Processed Acre Doses	Percent Recovery
1	Agric. Res. Service	2,727	1,680	61.6
2	Reuter	27,034	18,000	66.6
3	Reuter	55,451	35,000	63.1
4	Reuter	66,039	57,800	87.5
5	Reuter	47,345	36,800	77.7
6	Espro	21,407	17,489	81.7
7	Espro	159,959	153,077	95.7
8	Crop Genetics	67,572	69,050	102.2
9	Crop Genetics	26,743	14,787	55.3
10	Crop Genetics	27,250	25,000	91.7
Totals		501,527	428,680	85.5

Table 3. *TM Biocontrol-1 Processing Company, Grams per Acre Dose, Total Grams, and Acre Doses by FS Storage Lot.*

FS Lot	Processing Company	Grams per Acre Dose	Total Grams	Acre Doses
1	Agric. Res. Service	2.50	4,200	1,680
2	Reuter	2.15	38,700	18,000
3	Reuter	1.83	64,050	35,000
4	Reuter	1.84	106,352	57,800
5	Reuter	1.84	67,712	36,800
6	Espro	0.47	8,220	17,489
7	Espro	0.317	48,525	153,077
8	Crop Genetics	0.29	20,229	69,050
9	Crop Genetics	0.58	8,575	14,784
10	Crop Genetics	1.247	31,333	25,000
Totals			397,896	428,680

Table 4. *Uses of Storage Lots of TM Biocontrol-1.*

User	FS Lot Number	Grams Used	Acre Doses
USFS R1	1	3,000	1,200
USFS R1	3	3,660	2,000
PNW Entomology	7	254	800
British Columbia Forest Service	3	36,600	20,000

Table 5. *Quantities of TM Biocontrol-1 in Storage.*

FS Lot	Grams	Acre Doses
1	1,200	480
2	38,700	18,000
3	23,790	13,000
4	106,352	57,800
5	67,712	36,800
6	8,170	17,383
7	47,011	148,300
8	20,124	68,690
9	8,575	14,784
10	31,333	25,000
Totals	352,967	400,237

Table 6. *Packaging of TM Biocontrol-1 in Storage at Corvallis, Oregon.*

USFS Lot#: 1

Processing Company: Agric. Res. Serv.
Grams per Acre Dose: 2.50

Date Stored: 06/19/85
Total Acre Doses: 480

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
1,200	480	1	480

USFS Lot#: 2

Processing Company: Reuter
Grams per Acre Dose: 2.15

Date Stored: 08/01/86
Total Acre Doses: 18,000

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
2,150	1,000	18	18,000

USFS Lot#: 3

Processing Company: Reuter
Grams per Acre Dose: 1.83

Date Stored: 09/30/86
Total Acre Doses: 13,000

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
1,830	1,000	13	13,000

USFS Lot#: 4

Processing Company: Reuter
Grams per Acre Dose: 1.84

Date Stored: 11/24/86
Total Acre Doses: 57,800

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
368	200	124	24,800
1,840	1,000	33	33,000

USFS Lot#: 5

Processing Company: Reuter
Grams per Acre Dose: 1.840

Date Stored: 11/24/86
Total Acre Doses: 36,800

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
368	200	54	10,800
1,840	1,000	26	26,000

USFS Lot#: 6

Processing Company: Espro
Grams per Acre Dose: 0.470

Date Stored: 03/29/89
Total Acre Doses: 17,383

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
47	100	170	17,000
180	383	1	383

USFS Lot#: 7

Processing Company: Espro
Grams per Acre Dose: 0.317

Date Stored: 10/17/90
Total Acre Doses: 148,300

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
31.7	100	483	48,300
158.5	500	100	50,000
317.0	1,000	50	50,000

USFS Lot#: 8

Processing Company: Crop Genetics
Grams per Acre Dose: 0.293

Date Stored: 02/01/91
Total Acre Doses: 68,683

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
202	690	1	690
293	1,000	68	68,000

USFS Lot#: 9

Processing Company: Crop Genetics
Grams per Acre Dose: 0.580

Date Stored: 10/07/93
Total Acre Doses: 14,784

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
49	84	1	84
58	100	57	5,700
580	1,000	9	9,000

USFS Lot#: 10

Processing Company: Crop Genetics
Grams per Acre Dose: 1.247

Date Stored: 01/31/95
Total Acre Doses: 25,000

Grams per package	Acre Doses per Package	Number of Packages	Total Acre-Doses
124.7	100	10	1,000
1247.0	1,000	24	24,000

Grand Total of all Storage Lots

Packages	Acre Doses
1,243	400,237

FIGURE 1. *Annual Douglas-fir Tussock Moth Nuclear Polyhedrosis Virus production by the Corvallis Virus Production Facility.*

FIGURE 1. Annual Douglas-fir Tussock Moth Nuclear Polyhedrosis Virus production by the Corvallis Virus Production Facility.

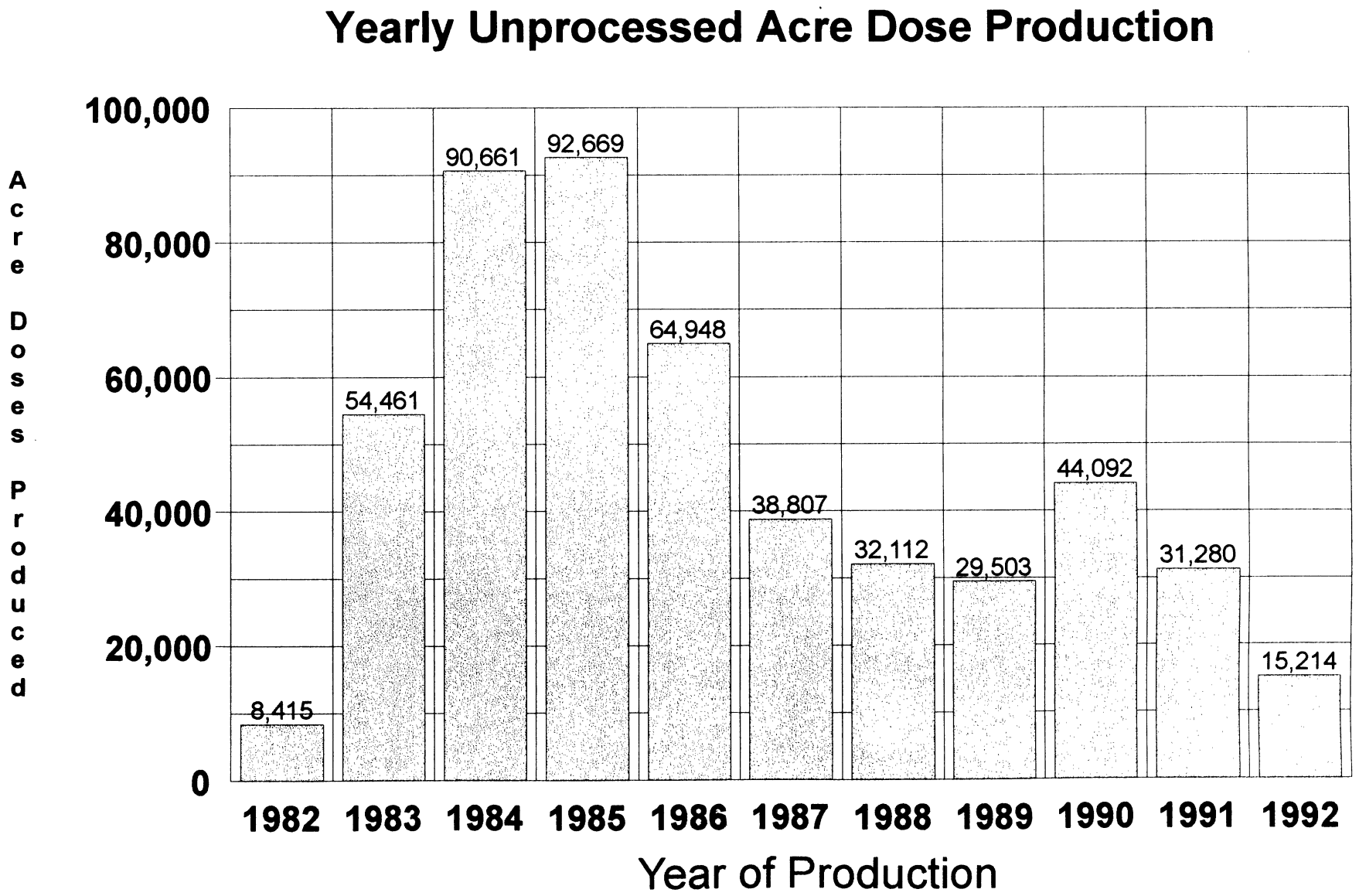

Figure 2. Registration label for TM Biocontrol-1

TM BIOCONTROL-1
BIOLOGICAL INSECTICIDE
FOR THE
DOUGLAS-FIR TUSSOCK MOTH

Active Ingredient:*
Polyhedral inclusion bodies of Douglas-fir tussock moth nucleopolyhedrosis virus 3.5%
Inert ingredients: 96.5%
TOTAL 100.0%
*Contains at least 3 billion activity units per gram.

KEEP OUT OF THE REACH OF CHILDREN
CAUTION
See other panel for additional precautionary statements.

For use by or under the supervision of the U.S. Forest Service

NOTICE: The U.S. Forest Service makes no warranty, express or implied including the warranties of merchantability and/or fitness for any particular purpose, concerning this material except those which are contained on the U.S. Forest Service's label.

EPA REG. No. 27586-1

Processed and Packaged for The USDA Forest Service,
BY: Espro, Inc.
8980 Oakland Ctr.
Route 108
Columbia, MD 21045

EPA EST. NO. 58971-MD-001
NET WEIGHT: 31 Grams LOT NO. 9001

DIRECTIONS FOR USE
GENERAL CLASSIFICATION

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For population reduction of the Douglas-fir tussock moth, apply by air at the rate of one package (31g.) TM Biocontrol-1 in 100 to 200 gallons finished spray per 100 acres. Stickers and u.v. protectants may enhance performance of this product. Refer to technical bulletin for mixing and application instructions. Spray tank mixture pH should be 6.0 to 7.2 **NEVER USE CHLORINATED WATER IN THE SPRAY FORMULATION.**

PRECAUTIONARY STATEMENTS
CAUTION
ENVIRONMENTAL HAZARDS

Avoid application to lakes, streams, or ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

STORAGE AND DISPOSAL

Activity may be impaired by storage above 80°F.

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container.

Pesticide, spray mixture, or rinsate that cannot be used should be disposed of in a landfill approved for pesticides or buried in a safe place away from the water.

Container disposal: Triple rinse and dispose of in an approved landfill or bury in a safe place.

Consult Federal, State, or local disposal authorities for approved alternative procedures.

Figure 3. MATERIAL SAFETY DATA SHEET FOR TM BIOCONTROL-1

MATERIAL SAFETY DATA SHEET[1]

(Form "Essentially Similar" to OMB No. 1218-0072)

PRODUCT NAME: **TM Biocontrol-1**	CHEMICAL NAME: **Nucleopolyhedrosis Virus of the Douglas-fir Tussock Moth, *Orgyia pseudotsugata***
FORMULA: **As a biological organism, this a.i. does not lend itself to characterization by normal pesticide criteria.**	MOLECULAR WEIGHT: **N/A**
SYNONYMS: **N/A**	CHEMICAL FAMILY: **N/A**

I. PHYSICAL DATA

BOILING POINT: **N/A**	FREEZING POINT: **N/A**
SPECIFIC GRAVITY ($H_2O=1$): **N/A**	VAPOR PRESSURE (mm Hg.): **N/A**
VAPOR DENSITY (AIR=1): **N/A**	EVAPORATION RATE (Butyl Acetate=1): **N/A**
% VOLATILES BY VOLUME: **N/A**	SOLUBILITY IN WATER (% by wt.): **Insoluble**

APPEARANCE AND ODOR:
Dried insect body parts and virus polyhedra.

II. HAZARDOUS INGREDIENTS

MATERIAL	PERCENT	TLV (Units)
N/A		

III. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED): **N/A**	FLAMMABLE LIMITS: **N/A**

EXTINGUISHING MEDIA:
Water on burning container.

SPECIAL FIRE FIGHTING PROCEDURES:
None except to avoid inhalation of particulates released by fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
N/A

[1] Prepared in compliance with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (29 CFR 1910.1200).

IV. HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE:	**Not established.**
EFFECTS OF OVEREXPOSURE:	**None known.**
EMERGENCY AND FIRST AID PROCEDURES:	**Remove from exposure situation.**
NOTES TO PHYSICIAN:	**Allergies and/or hypersensitivity may occur in some individuals.**

V. REACTIVITY DATA

STABILITY: UNSTABLE ☐ STABLE ☒

CONDITIONS TO AVOID	**Do not store in sunlight or at high temperatures.**
INCOMPATIBILITY (materials to avoid	**N/A**
HAZARDOUS DECOMPOSITION PRODUCTS	**N/A**

HAZARDOUS POLYMERIZATION: MAY OCCUR ☐ WILL NOT OCCUR ☒

CONDITIONS TO AVOID	**None**

VI. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	**Containment and cleanup by placing in a sealable container for transport to an approved landfill or other disposal site.**
WASTE DISPOSAL METHOD	**Burn bags or triple rinse containers and dispose them and excess product at an approved site.**

VII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)	**Use normal work clothing and medical face mask as appropriate.**
VENTILATION: LOCAL EXHAUST	**N/A**
MECHANICAL (general)	**N/A**
PROTECTIVE CLOTHING:	**Goggles and face mask as appropriate.**
OTHER PROTECTIVE EQUIPMENT:	**None except to have eyewash, soap, and water available.**

VIII. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	**Keep out of reach of children.** **For use only in USDA-FS-supervised projects.** **Avoid direct application to water.** **Do not contaminate water by inappropriate disposal.**
OTHER HANDLING AND STORAGE CONDITIONS	**Avoid heat and sunlight.** **Dispose in approved sanitary landfill or by incineration, as allowed by State and local authorities.** **Do not reuse "empty" containers.**
DEPARTMENT OF TRANSPORATION	HAZARD CLASSIFICATION: **Non-hazardous, non-toxic** SHIPPING NAME: **Nucleopolyhedrosis Virus**
EPA REGISTRATION #	**27586-1**
NAME	**Nucleopolyhedrosis Virus**

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Figure 4. Tank mix instructions for TM Biocontrol-1

TECHNICAL BULLETIN

TM BIOCONTROL-1
EPA Reg. No. 27586-1

Care must be taken in the mixing and application of this product.

TM BIOCONTROL-1 should be applied at the rate of 1.1 billion Activity Units per acre. Viability of TM BIOCONTROL-1 may vary substantially between Lots and will be indicated for each Lot in billion Activity Units per gram.

Stickers and ultra videt (u.v.) absorbers may enhance performance of this product.

Apply at the rate of 1 to 2 gallons spray mixture per acre. Ingredients of the final spray mix include:

TM Biocontrol-1	No. of grams to equal 1.1 billion Activity Units per acre
NaOH (Sodium hydroxide)	Amount sufficient to adjust pH to 6.0 to 7.2
Molasses	0.25 gallon
Sunscreen	0.5 pound - Use lignosulfonate or fluorescent whitening agent
Water	0.72 gallon

Small trial sample (100 ml) should be prepared using water from the intended field source to determine the amount of NaOH needed to adjust the pH. NEVER USE CHLORINATED WATER IN THE SPRAY MIXTURE.

Mixing sequence for conventional mixing equipment:

1. Fill tank with water and start agitation.
2. Add NaOH and mix for 5 to 10 minutes or until all NaOH pellets have dissolved.
3. Add sunscreen by slowly pouring onto the surface of the water while under agitation. Avoid large lumps of powder.
4. Add molasses by slowly pouring into mixture and mix thoroughly.
5. Check pH.
6. The carrier mixture can be prepared the day before use. TM Biocontrol-1 is added the morning of application and the final formulation mixed for 10 to 30 minutes.
7. Unused finished spray mixture can be kept 48 hours if the pH is checked to see that it does not exceed 7.5.
8. The mixing equipment should be provided with some type of in-lines filtering device, which would allow the mixture to be circulated while under agitation. If any foreign materials are in the mixture, the in-line filtering process can be used to remove them. Always use an in-line filter when loading spray mixtures.

NOTE: Read label thoroughly before using. Follow all label cautions and directions.

Part 1

TO: DISTRIBUTION (Title: Distribution list)

Part 2

Thanks Iral for the update. Iral, and others--I need your thoughts about this "early strike" notion of treating dftm. Can you be supportive of and perhaps participate in a project to test this notion? What we are responding to is a perceived need to reduce as much defoliation and tree mortality as possible to protect endangered species and their habitat. In my opinion some of the other resources are less important, but the managers may appreciate the option of early treatment. I think we all agree that there is considerable risk in doing an early treatment as we know that our preductive capabilities of where the significant defoliation will occur are lacking. However the potential benefits of protecting certain habitats are very high and may be worth the risk of treating some areas which wouldn't have received the defoliation. Another aspect is whether deploying the virus in this manner will "mess up" natural processes and interfere with our ability to manage dftm. What thoughts can you share with me to help me prepare a proposal?

> hi -
> as you may or may not know, dick reardon and i have been working closely with
> imre otvos on bioassay of tm- biocontrol. this was in part due to questions
> posed by the dftm technical group. this past sunday, dick and i met with imre
> and barbara to discuss the results to date and determine the next steps in the
> bioassay. attached is a short synopsis of the bioassay work and preliminary
> results to date.
>
> since dftm populations appear to be on the increase over a wide area in wa and
> or, there is potental that in the next couple years we may use a significant
> amount of the virus and it is possible that we could use it up (although my gut
> feeling thinks more like a couple hundred acre doses at most).
>
> john/don/beth/roger - dick asked that the dftm technical committee evaluate
> this situation to provide guidance on where to go from here. the furture
> proposed work is the completion of the bioassays; and conduct a foliage feeding
> study.
> imre was not sure about whether he could include an 038 study, at this time.
> (i personally am not looking forward to trying to deal with railroad carloads
> of molasses and would dearly love to see carrier 038 work, so i would like to
> see him conduct these tests - we will be talking to him later about this some
> more).
> other questions dick had were - 1) what studies does the dftm technical
> committee see should be done on tm-biocontrol?
> 2) if, in fact, we use all or most of the virus in the next couple years - how
> much additional money/effort should he be putting into tm-biocontrol;
> and 3) what are we going to do once it is depleted.
>
> these are some questions that he would like some guidance on in the fairly near

> future, because he will be finalizing his agreement with imre for the next
> fiscal year in the near future and recommendations may have some guidance on
> what that is. john - i will call and discuss more week after next.
>
> also, as an aside, roger is proposing a tdp/pilot study to look at the "early
> strike" technology of treating the same year that we would anticipate seeing
> the first light defoliation; and i have been in contact with gary d. about
> trying mating disruption on a pilot study level.
>
> more later
> ~~iral~~
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